Failed solutions to the energy crises: nuclear power, coal conversion, and the chemical industry in West Germany since the 1960s

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Abstract: *»Fehlgeschlagene Wege zur Bewältigung der Energiekrisen: Kernkraft, Kohleveredelung und Chemieindustrie in der Bundesrepublik seit den 1960er Jahren«.* By the end of the economic boom in the 1960s, the oil crisis caused an enormous rise in energy prices. Chemical companies, especially, faced a huge challenge due to their dependency on oil as an energy resource and raw material. This paper explores the reaction of West German chemical corporations to the energy crises of the 1970s and their attempts to anticipate future energy crises. First, the companies tried to implement their own industrial nuclear power stations to cut costs and to become more independent from oil. Second, and with the help of the social-liberal government, they attempted to revive coal conversion technology.

Keywords: Nuclear energy, coal refinement, coal conversion, chemical industry, energy crisis.

1. Introduction

In January 1977, the German magazine *Der Spiegel* published the headline "Conflict over the energy gap – The great illusion of nuclear power," referring to the latest critique of the heavily subsidized nuclear power stations (NPS). From the proponents' point of view, as well as that of the majority of West Germans, there was no alternative to nuclear power as a substitute for coal and gas. At the time, politicians of different political parties supported this argument. For instance, Social Democratic Federal Minister of Research and Technology Hans Matthöfer (1974-78) claimed the lights would go out without nuclear power. His colleague, Federal Minister of Economics Hans Friderichs (1972-77), also saw no alternative to the expansion of nuclear energy. Critics denounced their argument, citing both the dangers of the new technology and the high costs of nuclear subsidies, which impeded the development of other energy technologies.[1] One of the most prominent propagandists of nuclear

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1 Atomenergie: Eine chaotische Entwicklung, 1977, *Der Spiegel*, January 3, 32-8.

power was Heinrich Mandel, an executive board member of the Rheinisch-Westfälisches Elektrizitätswerks AG (RWE), which cooperated closely with the chemical industry, the largest consumer of industrial electrical power in West Germany. With more than 500,000 employees, West Germany's chemical industry sector contributed to ten percent of the manufacturing sector's sales and was a pillar of the national economy. By the 1970s, this energy-intensive industry used about 12 percent of West Germany's total petroleum consumption, and its electricity intensity, which is a ratio of energy use to gross monetary value, was considerably above that of the manufacturing sector.[2] The chairman of BASF's executive board, Carl Wurster (1952-65), and his successor, Bernhard Timm (1965-74), had been pursuing the idea of peaceful nuclear energy since the end of World War II. The chairman of Hoechst's executive board, Karl Winnacker (1952-69), also made a case for its use, to remain competitive. Winnacker was also president of the German Atomic Forum (*Deutsches Atomforum*) from 1959 onwards; Mandel succeeded him in 1973.[3]

By the end of the 1960s, the close relationship between the chemical industry and nuclear energy became especially apparent. Since the late 1950s, West German chemical companies had been following the international trend of using petrol chemistry. The rise of petroleum accompanied Europe's economic boom in the 1950s and 1960s. By the end of the boom, the monetary system had collapsed, economic growth had slowed down, and international competition had intensified.[4] Chemical companies had to react to these challenges, and cheap nuclear energy promised to be a key part of the solution. In 1969, BASF applied to construct its own NPS on its company grounds at Ludwigshafen, and Hoechst's management also considered the nuclear solution. Both companies' management called for the expansion of atomic power and to relegate oil and gas primarily to processing needs. Given the chemical industry's energy needs and the rising energy costs, which began to climb in the mid-1960s, the companies anticipated the approaching energy crisis even before the oil price shock in 1973, and they regarded nuclear power as a viable future technology. The first part of this article analyzes the companies' strategies for solving the energy supply problem, beginning in the late 1960s. It answers why their attempt to produce their own nuclear power failed.[5]

The 1973 oil price crisis aggravated chemical corporations' resource acquisition. In Germany, this event incited a second development in response, one that focused on the advancement of coal as a central energy source. Since West Germany's chemical corporations already had knowledge of how to conduct

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[2] Streck 1984, 319-25.

[3] Timms Sterne, 1965, *Der Spiegel*, June 23, 41; Radkau 1998, 173-96.

[4] Abelshauser 2011, 283-301.

[5] Abelshauser 2002, 507-14; Radkau 1983, 377-80. This part of the text makes recourse to sources of the *Bundesarchiv Koblenz* (BAK) and the *Landeshauptarchiv Koblenz* (LAK).

coal liquefaction and gasification, the industry was invested in the attempt to revive coal. After the crisis of the West German coal industry in 1957/58, increasing oil prices offered the chance for recovery, and the Social Democratic government, which had a close relationship with mineworkers, availed themselves of the opportunity to support the mining sector. The second oil crisis in 1979/80 reinforced the impression of resource dependency and gave rise to the continuation of coal-to-chemical plants. The second part of this article concentrates on the main actors in this arena – what relationship networks existed, how did industry and politics react to the energy crises, and why their technological strategies did not succeed?[6] It highlights the bargaining positions of the different business and government actors and explains why these two ways out of the energy crises failed.

2. The Idea of Nuclear Energy in the West German Chemical Industry (1967-1976)

By the end of the 1960s, West German chemical companies were heavily dependent on petroleum and interested in using nuclear power and coal chemistry as substitutes for oil. At the same time, water and air pollution had become important topics in West Germany's public discourse, and criticism of nuclear technology emerged.[7] Thus, to construct an NPS, the companies had to overcome safety-related technical barriers associated with the reactor pressure vessel and the risk of meltdown, as well as pass public criticism.

In the 1950s, Hoechst had already started producing heavy hydrogen and had invested in nuclear fuel reproccessing. Unlike its competitor BASF, Hoechst regarded nuclear technology as a profitable business endeavor. However, compared to other business sectors, radiochemistry at Hoechst remained an operation of little importance until the end of the 1960s.[8] Because of rising energy prices in the second half of the decade, interest in nuclear technology rose again, and Hoechst established an energy economy commission (*Kommission Energiewirtschaft*) to develop its energy strategy.[9] In July of 1968, at a meeting with the two RWE directors, Helmut Meysenburg and Heinrich Mandel, Winnacker stated that the decision for a new electrolysis plant would es-

[6] The second part of the text is mostly based on materials from the Business Archive of Hoechst (BAH) and the *Wirtschaftsarchiv der Universität Köln* (WAUK), as well as on documents from the *Landesarchiv Saarbrücken* (LAS), the *Bergbau-Archiv Bochum* (montan.dok BAB), and the *Stiftung Westfälisches Wirtschaftsarchiv* (WWA).

[7] Kupper 2003, 325-48; Radkau 2011, 209-29.

[8] Abelshauser 2002, 508; BAH, H0121363, Hoechst und die Kerntechnik (19.04.1973); Atomkraft in Deutschland, 1955, *Die Zeit*, November 3, 3; Schweres Wasser aus Höchst, 1957, *Die Zeit*, May 30, 15; WAUK, Hoechst heute, no. 48, Energie von morgen, 2-4.

[9] BAH, H0128716, Protokoll der 1. Sitzung der Kommission Energiewirtschaft (25.11.1968).

sentially be dependent on the price of electricity. He tried to put pressure on the energy provider to lower energy costs, but RWE was in a favorable position due to its dominant market position and Hoechst's growing energy demand. So the conversation turned to the question of how to solve the company's energy problem in the long term.[10]

In 1969, more than 85 percent of the primary chemicals Hoechst used to produce organic goods were petroleum based. As a result, Hoechst was in favor of dissolving the compound structures of energy and resources and producing more electricity by NPS, thereby allowing the demand and price formation on the commodity markets to ease up and the price of oil and electrical power to fall. From Winnacker's point of view, constructing their own NPS would be perfect, because the plants could supply Hoechst with low-priced electrical power and with enough steam to run their chemical production process.[11] As such, Winnacker represented the typical attitude of West German industrialists – i.e., nuclear electricity could help overcome increasing power demand and future energy crises. In the meantime, Hoechst became aware of other NPS projects by energy suppliers and BASF. Winnacker was skeptical that these projects would be realized in the near future, but Meysenburg assured him that the large industrial projects would take first priority. In the case of Hoechst, the NPS would go into operation in 1974, and by 1980 a second reactor block would be completed. RWE would undertake the construction and management of the NPS and close a long-term contract with Hoechst for the delivery of electric power and process steam.[12] At this point, the first differences between the chemical and the energy industry emerged. Hoechst wanted to contruct two reactor blocks immediately; otherwise, a boiler plant would have been needed to guarantee a steam reserve, should the existing block-unit break down. However, RWE threatened to withdraw from the whole project if Hoechst did not accept their terms.[13]

Hoechst eventually decided that RWE's offer was not attractive. The chemical corporation would have had to implement additional services, such as feedwater or steam supply lines, and RWE was willing to offer better energy prices only if there was an additional power demand. Since the two companies' price targets were too different, Hoechst decided to give up the idea and instead use traditional delivery contracts to satisfy its power demand.[14] Nevertheless,

[10] BAH, H0128704, Besprechung RWE – FWH (11.07.1968).

[11] BAH, H0128705, Hans Schlachter, Die Energiestruktur und ihre Auswirkungen auf die Energiekosten in einem Unternehmen der chemischen Industrie, *VIK-Mitteilungen* 6/7, 1969, 1-9.

[12] BAH, H0128704, Besprechung RWE – FWH (11.07.1968), RWE an Farbwerke Hoechst (29.01.1969).

[13] BAH, H0128704, Aktennotiz betr. Besprechung mit RWE (18.02.1969).

[14] BAH, H0128716, Protokoll der 2. Sitzung der Kommission Energiewirtschaft (20.03.1969); BAH, H0128704, Sammet und Wagner (Hoechst) an RWE (03.03.1969), Notiz über eine Besprechung mit Klette und Rittstieg (03.03.1969).

the management was optimistic about the future of nuclear technology and, in the 1970s, invested more than seven million DM in research on reprocessing and uranium enrichment.[15] This shows that, in principle, the management had no doubts about the technology, but economic considerations determined the decision. The idea of an industrial NPS was dropped before the review of a suitable location had even begun. In doing so, Hoechst avoided difficult applications and procedures for – and protests against – an NPS in Frankfurt's exurban fringe.

In the case of BASF, the Arab-Israeli Six Day War and Nigeria's civil war in 1967 intensified the management's awareness of the vulnerability of the firm's energy supply. At the same time, the company wanted to counter the energy sector's rising development costs. After cooperation with RWE and Großkraftwerk Mannheim to construct a joint NPS had failed, on May 7, 1969, BASF requested approval of an industrial NPS with double power of a 660-megawatt plant from the Rhineland-Palatinate's Ministry of Economy. The start of construction was planned for 1971. Willi Danz, a member of the BASF executive board, argued that this was the only way the company could stay competitive in global markets. In 1968, energy costs accounted for thirty percent of production costs at the Ludwigshafen plants, or more than DM 400 million. Although the investment costs for an NPS were higher compared to oil or coal-fired power plants, operating and energy costs were much lower since nuclear fuel was cheaper. The NPS would provide both electrical power for the BASF site and process steam for chemical reactions, similar to Hoechst's NPS. It made sense for BASF to build an NPS on their premises, because steam could not be transported over long distances.[16]

Approval of the NPS was required not only by the Rhineland-Palatinate Ministry of Economic Affairs under Hanns Neubauer (CDU), who supported the planning, but also by federal regulatory bodies. Consequently, the responsibility of approval shifted to the Reactor Safety Commission (*Reaktor-Sicherheitskommission*), an advisory board of the Federal Ministry of Research. In 1969, the Reactor Safety Commission created its own "safety philosophy" around nuclear technology in the Federal Republic and discussed the dangers of a suburban NPS. The Federal Ministry of Research advocated for a reactor outside urban areas. Its reluctance was based in the fact that BASF's reactors near Ludwigshafen and Mannheim would have created a precedent of allowing an industrial NPS in close vicinity to two large cities. Furthermore, in the case of war, the Federal Ministry of Research's position was to shut down all nucle-

[15] BAH, H0121364, Janson an Arbeitsgruppe Kerntechnik (18.12.1972), Betätigung von Hoechst auf dem Gebiet der Kerntechnik mit Anlage (01.11.1972), Sammet an Fischer, Kremer und Harnisch (07.02.1973).

[16] Abelshauser 2002, 507-10; BAK, B106/52702, Darlegung und Begründung des Projekts zur Errichtung eines Kernkraftwerks (03.06.1969), BASF an Minister für Wirtschaft und Verkehr des Landes Rheinland-Pfalz (07.05.1969); Radkau 1983, 100-5, 376-7.

ar power stations. If nuclear power expanded, and West German energy production changed fundamentally, this position would have had to be reconsidered. Considering the Cold War, this was another argument against quick approval. The major chemical accidents at BASF in 1921 and 1948 also caused the mayor of Mannheim to express concern about locating the facility within a ten-kilometer radius of two large cities with half a million people.[17]

Thus, concerns about nuclear power were raised not just during the famous protests at Whyl in 1975. While the societal majority supported nuclear energy, at the end of the 1960s, there were already successful petitions and protests against an NPS on the local level. In light of the increasingly critical public, Hans Leussink, head of the newly established Federal Ministry of Education and Science, postponed the decision for two years and, in August of 1970, initiated a DM-137-million, four-year research program. But the moratorium did not alter the German government's fundamentally positive attitude about nuclear power; the conflict between energy security concerns and the risks of nuclear power came into the open. After confidential meetings between Leussink and BASF the Minister thought that he had acted in agreement with BASF. But, in fact, the company did not agree with his approach. Based on this misunderstanding, in November 1970 the Rhineland-Palatinate Minister President Helmut Kohl (CDU) made allegations against German Chancelor Willy Brandt (SPD) about the contradictory statements of the Ministry and BASF. Kohl also accused Leussink of unnecessarily unsettling the public about future nuclear technology with his public address. Brandt completely dismissed the allegations. On the one hand, this exemplifies typical disputes within a federal system; on the other hand, it demonstrates the power struggle between Brandt and Kohl for political leadership in West Germany. Leussink refused to grant BASF a license for the project in October of 1970, after the differences between the government and BASF had become obvious. However, he did not dismiss the atomic law, as Kohl had claimed.[18]

A multi-year discussion about the dangers of a suburban NPS had now begun; by 1972, a decision had yet to be reached. BASF answered a catalog of questions about additional safety devices, but the Reactor Safety Commission

[17] BAK, B106/52702, Ministerium für Wirtschaft und Verkehr an Bundesminister für wissenschaftliche Forschung (22.08.1969), Ergebnisprotokoll über die Sitzung der RSK (24.09.1969); BAK, B106/52703, Oberbürgermeister der Stadt Mannheim an Ministerium für Wirtschaft und Verkehr (24.02.1970); LAK, 860/11015, Holkenbrink an Leussink (01.12.1971), Ministerpräsidentenbesprechung (28.01.1972); LAK, 860/11138 Vorlage für den Ministerrat von Neubauer (21.01.1969); LAK, 950/7176 Besprechung des Kabinetts mit dem Vorstand der BASF (20.01.1969); Radkau 1983, 378-84; Radkau 1993, 106-7.

[18] BAK, B106/52703, Überprüfung der sicherheitstechnischen Anforderungen (17.08.1970), BASF an Leussink (19.08.1970), Vermerk BMBW IV-C-1 (01.09.1970), Entwurf BMBW an BASF (07.10.1970), Neubauer an Leussink (23.06.1970, 01.10.1970), Leussink an Neubauer (30.07.1970, 09.10.1970), Kohl an Brandt (10.11.1970), Brandt an Kohl (22.12.1970); BAK, B106/52707, Anlage 1 zur Kabinettsache des BMwF (30.07.1970).

did not come to a conclusion and demanded proof of the emergency cooling system and a functioning crash ring (*Berstschutz*). According to the Department of Nuclear Safety and Radiation Protection (*Reaktorsicherheit und Strahlenschutz*), a special agency within the Federal Ministry of Education and Science, the request for experimental assurance of the crash ring was arbitrary. The department feared that if they granted permission to BASF, they could not deny similar applications for industrial suburban nuclear power stations. Furthermore, until 1972, the United States, the United Kingdom, and France had not approved an NPS in an urban area – and, until the early 1970s, West Germany followed Amercian nuclear security policy.[19] Two problems became priorities. First, clarification was needed on whether an NPS would ever be allowed in a metropolitan area; and second, additional security measures for an urban NPS had to be determined. After several expert committees saw no reason to exclude the location at Ludwigshafen, the discussion shifted to coming up with "adequate" protection measures against accidents and external influences.

The leadership of the Federal Ministry of the Interior, particularly, had concerns. In the early 1970s, Interior Minister Hans-Dietrich Genscher (FDP), a liberal, had discovered environmental policy as fodder for good publicity, and in 1973 he managed to incorporate the Department of Nuclear Safety and Radiation Protection into his Ministry; thus, the responsibility for the BASF project moved under his purview. In the view of the Interior Secretary, Günter Hartkopf, the public was not ready to accept an NPS in a metropolitan area. Genscher and Hartkopf consciously stirred up public reservations about nuclear power. Hartkopf's proposal to suspend all NPS construction projects until a final negotiation sparked a wave of indignation. Under these circumstances, the president of the Reactor Safety Commission, Dieter Smidt, predicted Germany would experience an energy gap; a response similar to that of many industrial managers who felt vindicated when the Organization of the Petroleum Exporting Countries (OPEC) limited production volumes in late 1973. Thus, the responsibility of energy policy had been passed on to another ministry, and the conditions of the energy supply fundamentally changed in 1973/74.[20]

Although the Deutsch Mark's appreciation partially compensated for the higher oil prices, chemical companies faced a great challenge, given their immense energy needs. Therefore, BASF maintained its nuclear application, and in September of 1973 the social-liberal government's energy program, which

[19] BAK, B106/52707, Besprechung mit BASF, KWU und Genehmigungsbehörde Rheinland-Pfalz (10.07.1972), Besprechung zwischen Keller (Siemens), Sahl und Seipel (06.09.1972); Prozeßdampf aus Kernkraftwerk, 1969, *FAZ*, December 23, 14; Radkau, *Aufstieg*, 379-81; Atomstrom. Kraft durch Kugeln, 1967, *Der Spiegel*, December 11, 105-8.

[20] Abelshauser 2002, 512; Abelshauser 2011, 392-401, 457-65; BAK, B106/52708, Sahl an Wolany (14.04.1973), Kurzprotokoll (24.04.1973); BAK, B106/52688, Kernkraftwerk BASF (Standort Mitte) Bd. 3 (1973-1974); Ditt 2005, 305-47.

provided for an expansion of nuclear energy, seemed to confirm the company's action. Many West German industrialists wanted to expand nuclear energy to be prepared for potential future energy crises. BASF CEO Bernhard Timm took advantage of the media attention for the energy problem and launched a high-profile public relations campaign in favor of the NPS. In the fall of 1974, BASF compiled the last outstanding documents and finalized an agreement on fissile material enrichment. The company believed it had answered every question to the utmost satisfaction, and it expected permit approval by February 1975. Yet, there was no consensus on residual risks. Although oil prices and raw material costs rose substantially in 1973 and 1974, and the German Council of Economic Experts (*Sachverständigenrat*) forecasted supply problems for the chemical industry, the federal government did not change its position. The federal cabinet discussed different types of energy substitutions and savings, but existing security concerns and the growing importance of environmental issues – as exemplified by the second Environmental Forum in Bonn on December 4, 1974 – rendered its decision not in BASF's favor.[21]

In addition to economic and social arguments such as job security and retention, BASF also tried to employ the environmental dimension. It drew attention to the lower sulfur and carbon dioxide emissions of nuclear power as compared to existing power plants. But the Federal Ministry of the Interior was not convinced. Instead, the new Interior Minister, Werner Maihofer, considered ending the application process in mid-1975, since the documents were incomplete.[22] The scientific and technical experts of the Reactor Safety Commission put technical safety standards first, whereas the Ministry of the Interior was concerned about the growing public criticism.[23] This negative attitude towards the project was obvious. So, in March of 1976, BASF Board members Matthias Seefeld and Berthold Frank presented an alternative site about five kilometers north of the original in a less populated region outside the factory complex. Maihofer welcomed the proposal; nevertheless, the Ministry demanded new analyses.[24] Now, BASF checked the efficiency of the entire project. Construction costs had risen from around DM 450-500 million to 2.1 billion, due to the extensive security requirements. At the end of 1976, the company concluded

[21] Abelshauser 2002, 512-513; BAK, B106/52709, BASF an Sahl (20.09.1974), Referat UA II 5 (25.10.1974, 06.12.1974); Hohensee 1996, 49-50; Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 1973, *Zu den gesamtwirtschaftlichen Auswirkungen der Ölkrise. Sondergutachten vom 17. Dezember 1973,* Stuttgart and Mainz: Kohlhammer.

[22] BAK, B106/52708, Energiesituation der BASF (November 1973); BAK, B106/52710, BASF-Kernkraftwerk am richtigen Standort (25.02.1975), Referat UA II 5 (21.02.1975, 05.05.1975).

[23] BAK, B106/52711, Referat RS I 3 (12.02.1976, 04.03.1976); Todesstrahlen aus dem Atom-Kraftwerk?, 1975, *Der Spiegel*, July 21.

[24] BAK, B106/52711, Vermerk zum weiteren BASF-Verfahren (15.03.1976), BMI an BASF (11.05.1976), Referat RS I 3 (18.05.1976); BAK, B106/52720, BASF an Ministerium für Wirtschaft und Verkehr (11.05.1976).

that the construction project was no longer profitable, even though the oil crisis had also caused the expected savings to climb – from DM 100 to 210 million per year.[25] Consequently, a seven-year period of negotiations came to a fruitless end. While BASF did not reject nuclear power in general, it made more sense to cooperate with a power supply company for economic reasons. With regard to West Germany's general energy production, Winnacker, Timm, and their colleagues correctly predicted that nuclear power would develop – nuclear-generated electricity by power supply companies increased enormously in the 1970s and 1980s. However, corporate-owned industrial NPS never became a solution to the post-boom energy supply problems. Instead, the chemical industry relied on a market-based solution.[26] The failure prevented the companies from using their own NPS to produce electricity and process steam, but it did not hinder the long-term success of the West German chemical sector. After the chemical industry overcame the structural and economic crises of the 1970s, it prospered again in the 1980s.

3. Coal Conversion after the Boom (1967-1986)

Oil was not only an important energy source, but it also served as the basis for many chemical products. Thus, in light of rising energy and raw material costs, entrepreneurs and politicians had to consider substitutions. In 1967, 79 percent of the raw materials used by Germany's chemical industry were dependent on oil. Because of this dependence, Hoechst Board member Rolf Sammet believed West Germany should expand its coal refining capacity.[27] The country possessed large coal deposits, and the chemical industry had a lot of knowledge about coal conversion, which it had acquired during the Nazi regime. The reactivation of carbon chemistry encountered economic difficulties because of the mining. With the extension of carbon use, mining's sales problems could be resolved and potential job losses could be prevented. In the second half of the 1960s, the idea of coal conversion was widely supported, since industry and government expected it would bring greater national energy independence in times of growing economic interdependence. But the viability of the technology had to be questioned. As Frederick Brüning, a board member of Scholven-

[25] Abelshauser 2002, 513; BAK, B106/52720, BASF an Maihofer (13.12.1976).
[26] For the production of electricity of West German power supply companies, see Statistisches Bundesamt, ed., 1965-1990, *Statistisches Jahrbuch für die Bundesrepublik Deutschland,* Stuttgart and Mainz: Kohlhammer.
[27] LAS, Staatskanzlei 1914, Sammet zu den Energiesorgen der Chemie (Kunststoff-Berater 12, 1967, 991).

Chemie, stated in April 1968, coal hydrogenation was indeed technically feasible, but it was not economical to operate without government aid.[28]

Before 1945, companies relied on two processes in addition to coking: the hydrogenation of coal and coal gasification prior to synthesis. Since then and until the early 1970s, the fundamentals of chemical engineering had changed little. On July 2, 1969, the German Bundestag mandated a study to examine possibilities for a resumption of fuel production from West German coal. The results, which were presented in 1970/71, concluded that the price efficiency depended mainly on the price ratio of coal to gasoline. At the time, liquid fuel from West German coal was 3.5 to five times more expensive than petroleum gasoline. So only political considerations could justify obtaining liquid fuel from coal.[29] A fast and cost-neutral transition was not in sight. But at the end of West Germany's "economic miracle," the country was not confronted with a great national debt, and many politicians still believed in the controllability of a complex national economic system. In March 1968, at a hearing on hydrogenation at the Landtag of North Rhine-Westphalia (NRW), representatives of the coal industry calculated that DM 200 of subsidies per ton of fuel would be necessary to generate hydrogenated fuel from coal.[30] At the same time, the Saarland state government examined coal recovery options. As mining companies in North Rhine-Westphalia, the Saarland mining company Saarbergwerke AG was affected by the energy market's structural change, and in 1965 it launched the Saarlor Chemical Project with Houillères du Bassin de Lorraine, under which the Saarland Refinery was put into operation. The Saarbergwerke AG sought to promote the upgrading of coal to electricity, coke, and gas, and to move into the production line of the oil industry.[31] Conversely, chemical companies, such as BASF, integrated back into the commodity sector and acquired the oil producing company Wintershall AG, for example. During the Middle East crisis in 1967, Willi Danz of BASF re-examined the use of coal. Combined with cheap nuclear power, coal hydrogenation seemed viable.[32] Thus, with their ideas to revive coal and to use nuclear power, politicians and entrepreneurs had anticipated the energy crises of the 1970s.

With the rise of crude oil imports into West Germany, which began in 1958, 1967's Six Day War made the vulnerability of the West German energy supply

[28] LAS, Staatskanzlei 1914, Ölhydrierung verhinderte Treibstoff-Kontingentierung (Energiewirtschaft 7 (15), 1968, 11.04.1968).

[29] Franck and Knop 1979, 131-86, 228-51; Schmalfeld 2008.

[30] LAS, Staatskanzlei 1914, Saarbergwerke AG, Reisebericht (06.04.1968).

[31] LAS, Staatskanzlei 1914, Chef der Staatskanzlei an Mitglieder des Ausschusses "Energie" (24.07.1968), 'Chemie in der Saarberg-Gruppe' von Otto W. Strüven (08.08.1968); LAK, 714/440, Saarberg – Energie und technischer Fortschritt, p. 22-23; LAK, 714/7620, Werkzeitschrift des Saarberg-Konzerns '*Saarberg – Zeitschrift des Saarberg-Konzerns*' 3/1967, Rohöl für die Saarberg-Gruppe, 15, *Saarberg* 11/1967, Saarland-Raffinerie produziert und liefert, 10.

[32] Abelshauser 2002, 454-6; Schröter 1996, 109-38, 129.

obvious. The anticipation of future energy crises set up discussion about conversion before the oil price shock. In this regard, in 1969 the Federal Ministry of Education and Science had approved a request from Mining Research (*Bergbau-Forschung GmbH*) to generate coal-based electricity through magnetohydrodynamic energy conversion. The research institution estimated an investment of DM 2.2 million was needed, of which the Federal Ministry of Education and Science took over 75 percent. However, the Ministry was still skeptical of coal gasification by nuclear reactor heat, and it questioned its profitability.[33] Despite this, coal gasification using nuclear process heat remained a theme throughout the 1970s.[34]

The first oil crisis of 1973/74 provided a new impetus to coal gasification and liquefaction. In this sense, the oil crisis was more of a catalyst than a cause. In the short term, chemical companies, such as BASF, once again had to rely on coal from their mines and on other petroleum fractions; but in the long term, the procurement of raw materials, the energy supply, and the production program had to be rebalanced. Therefore, in the midterm, the BASF board directed the development of an energy savings program and refocussing on specialty products.[35] At the Hoechst sites in the Rhine-Main area, about 30 percent of the energy needs normally covered by oil were met by coal and natural gas instead during the highest point of the crisis.[36] In May 1973, the Federal Ministry for Research and Technology (FMRT) initiated an analysis of energy-saving technologies. The experts were to formulate concrete results within two years; but when the oil crisis necessitated a revision of existing energy demand forecasts, the deadline was moved to 1977/78. The 4,000-page study concluded that the chemical industry's energy consumption for the production of basic organic substances could be reduced 30 to 40 percent by increasing efficiency, installing energy recovery systems, and implementing new technologies.[37] Likewise, in September 1973 the social-liberal coalition's energy program called for an expansion of nuclear energy as part of energy diversification and attached major importance to coal as a safety cushion, particularly for the electricity supply. Despite cost disadvantages as compared to oil, this program was

[33] Montanhistorisches Dokumentationszentrum (montan.dok) beim Deutschen Bergbau-Museum Bochum (BBA), 122/281, Forschungsvorhaben (28.10.1968), Bericht von Reerink und Peters über Forschungsvorhaben; montan.dok BBA, 122/282, Aktenvermerk betr. Besprechung mit BMBW (25.11.1968).

[34] Franck and Knop 1979, 178-182; montan.dok BBA, 122/15, Aktenvermerk D. Wiegand betr. Programmstudie 'Sekundärenergiesystem' (04.07.1975); Schröter 2000, 394-5.

[35] Schröter 1996, 128-30.

[36] WAUK, Business Report Hoechst 1974, 31-3.

[37] Montan.dok BBA, 122/15, Aktennotiz von Hagemann (08.01.1974), Bericht für BMFT-Kurzstudie 'Entwicklung der Energiepreise' (09.01.1975); montan.dok BBA, Notiz betr. Besprechung der geplanten 'Studie über Technologien zur Einsparung von Energie' (30.05.1973); montan.dok BBA, Kurzzusammenfassung von Ergebnissen der Studie 'Technologien zur Einsparung von Energie' (July 1976).

implemented to assuage the uncertainty of the world energy markets and reduce the dependence on imported energy. Energy policy reasons, as well as social and regional policy considerations (with regard to North Rhine-Westphalia and Saarland), compelled the federal government to take this view. Only one year later, the government increased investment in the coal sector from DM 160 to 210 million.[38] This increase was accompanied by a large number of projects in which chemical and mining companies operated on coal conversion with government research support. Although the vertical integration of chemical and mining companies could have resulted in conflict, state support offered the opportunity of a win-win situation. Chemical companies wanted to cut their raw material and energy costs and develop new businesses, whereas the mining industry tried to restore a profitable production. Many politicians predicted coal would provide a golden future, and many mining companies hoped for the black diamond's renaissance.[39]

The rise of oil prices brought options for substitutions back into discussion, and in 1974 the government announced further projects to develop advanced coal conversion processes.[40] The 1974-1977 Energy Research Program (*Rahmenprogramm Energieforschung*) assumed that natural gas and oil reserves would dry up in the coming decades. Hence, coal and nuclear energy should be able to meet future energy needs. Priority was placed on the development of coal liquefaction processes, coal pressure gasification, coal gasification with nuclear power heat, and the production of raw materials for the chemical industry.[41] Concerned with high energy prices and market uncertainties, the chemical industry established a coal conversion working group within the German Chemical Industry Association, which became an advisory board of the Federal Ministry for Research and Technology in 1976.[42] On October 25, 1972, Saarland had already presented an energy policy concept, which was integrated into an energy program in 1974. The Saarbergwerke AG was well prepared for this challenge and explored coal hydrogenation; their results would enable the construction of a pilot plant starting in 1977. At the same time, the Saarbergwerke AG received 75 percent of the funding for a DM-40-million pres-

[38] Bundestagsdrucksache 7/1057, 7. Wahlperiode, Unterrichtung durch die Bundesregierung, *Die Energiepolitik der Bundesregierung* (03.10.1973); Bundestagsdrucksache 7/2713, 7. Wahlperiode, Unterrichtung durch die Bundesregierung, *Erste Fortschreibung des Energieprogramms der Bundesregierung* (30.10.1974).

[39] Montan.dok BBA, 122/159, Aktenvermerk über das 6. Gespräch zwischen Wissenschaft und Wirtschaft (22.11.1973), Hans-Dieter Schilling: Die technischen Möglichkeiten sind vorhanden, Peters: Interview 'Comeback' der Steinkohle? Umschau 74 (1), 1974, 3. The idea to extend the uses of coal was also common in the U.S., Great Britain, Japan and the Netherlands. See montan.dok BBA, 122/183, Aktenvermerk Schilling betr. Energy Coordinating Group (15.05.1974).

[40] Montan.dok BBA, 122/163, BMFT-Mitteilungen 2, 1980, 26.02.1980.

[41] LAS, Z75, *Saarberg* VI/1974, Kohleforschung wird vorangetrieben, 9-10.

[42] Schröter 2000, 388-90.

sure gasification project, which began in 1975, and cooperated with BASF on coal conversion.[43] Some years later, Federal Research Minister Volker Hauff (1978-80) put the coal gasification demonstration plant in Völklingen-Fürstenhausen into operation, which then produced synthesis gas for the chemical industry. It was the world's largest facility of its kind, demonstrating the strong will of chemical companies, the mining industry, and politicians to implement a new energy mix for West Germany.[44]

Chemical companies with a primary interest in the production of basic chemicals were involved in such research and cooperated with mining companies. This inter-sectoral cooperation was typical for the West German production regime. From 1975 onwards, the research program of Ruhrchemie AG, a subsidiary of Hoechst, targeted the recovery and substitution of resources. Ruhrchemie cooperated with Ruhrkohle AG and established a large scale, pulverized-coal pressure gasification operation, which was funded by the Federal Ministry for Research and Technology, to substitute heavy fuel oil with coal.[45] The costs of the plant, built in Oberhausen-Holten in 1977, amounted to DM 30 million, of which 60 percent was funded by the state. Minister Hauff considered a viable West German coal industry as insurance against oil price increases and future energy crises.[46] Although oil prices rose again in the second crisis and, in 1980, Ruhrchemie considered its coal gasification process well-engineered, the company still requested further government support. By the spring of 1980, it was able to produce organic chemicals from synthetic gas and sell licenses for using new methods to U.S. companies. Hence, the development and export of process technology also became economically important. New methods and machines offered promising business opportunities to the export-oriented German economy.[47]

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[43] LAS, Z75, *Saarberg* 1974, Kohle zunehmend gefragt, II/74,7, Überwindung der Energiekrise, III/74, 11-23, Energieprogramm für das Saarland, VIII/74, 15; LAS, Z75, *Saarberg* 1975, Öl aus Steinkohle, VIII/75, 11; LAS, Z75, *Saarberg* 1976, Forschungsministerium unterstützt Saarberg-Hydrierung, III/76, 7; LAS, Z75, *Saarberg* 1977, Technologiezentrum Saar für Kohle-Druckvergasung, III/77, 11; LAS, Z75, *Saarberg* 1979, Autos fuhren mit Saarkohle-Benzin, VI/79, 3.

[44] LAS, Z75, *Saarberg* 1980, Neue Demonstrationsanlage zur Kohledruckvergasung im Saarland, III/80, 5-6; LAS, Z75, *Saarberg* 1981, Gesellschaft für Kohleverflüssigung gegründet, V/81, 11; LAS, Bestand Saarberg Saarbergwerke AG, no. 81, Saarberg: Kohleverflüssigung – Coal Liquefaction, no. 84, Saarberg – Neue Entwicklungen: Kohleverflüssigung, 12-8.

[45] Schröter 2000, 391-2; WWA, Dortmund, 7, Business Reports no. 418, Ruhrchemie 1975, 8, Ruhrchemie 1976, 9, Ruhrchemie 1978, 8, Ruhrchemie 1979, 8; WAUK, Business Report Ruhrkohle AG 1974, 8.

[46] WWA, Dortmund, 32, no. 226, Aus Steinkohle soll Synthesegas werden, 1977, *Süddeutsche Zeitung*, March 31; Bei Ruhrchemie wird Gas aus Kohle gemacht, 1978, *WAZ*, April 4; Kohlegas auch für Chemieprodukte, 1980, *Blick durch die Wirtschaft*, February 23; WWA, Dortmund, F 1968, 361/78, Ruhrchemie AG, ed., 1978, *Ruhrchemie 1927-1977*, 80-2, Düsseldorf: Econ.

[47] WWA, Dortmund, 7, Business Reports no. 418, Ruhrchemie 1979, 8, Ruhrchemie 1980, 8, Ruhrchemie 1981, 8, Ruhrchemie, 1982, 7, Ruhrchemie 1983, 7.

Table 1: Pilot Coal Gasification Plants in West Germany (1974-1982)

Company	Rh. Braunkohlen AG	Rh. Braunkohlen AG	Ruhrkohle / Ruhrchemie	Ruhrkohle / Ruhrchemie / Steag	Shell AG	Saarbergwerke AG	VEW AG	PVC (Flick) / Sophia Jacobs
Energy	brown coal	brown coal	black coal	black coal	black coal	black coal	black coal	black coal
Cost in mio. DM	32	150	48	150	100	71	25	25
State funding	65% (FMRT)	75% (FMRT)	60% (FMRT)	75% (FMRT)	(EC)	75% (FMRT)	65% (FMRT)	80% (NRW)
Location	Frechen	Wesseling	Oberhausen	Dorsten	Harburg	Völklingen	Stock-um	Hückelhoven
Planning/ construction	1974-78	1979-83	until 1978	1974-79	1976-78	1975-78	until 1976	until 1979
Trial phase	1978-81	1982-83	since 1978	1979-83	1979-80	1979-81	1977-80	since 1979
Operating status	1978	1982	1978	1979	1979	1979	1977	1979

Source: montan.dok BBA 122/163, BMFT-Mitteilungen 2/1980, 26.02.1980, 18.

The second oil price shock underlined the political vulnerability of oil supplies and triggered a second phase of acceleration in energy policy. The German government again prioritized its domestic coal. In 1980, the federal government passed a coal conversion program, which included a total of 14 coal gasification and liquefaction projects. By 1993, it would invest a total of DM 13 billion. Export opportunities for West German coal conversion technologies particularly increased. Minister Hauff explained that coal conversion could become the most important cornerstone of long-term energy and raw material supply, and he called West Germany one of the leading nations in this field thanks to state-sponsored pilot projects in the 1970s. Between 1974 and 1980, the Federal Ministry for Research and Technology had invested DM 650 million in new coal conversion technologies. This included seven pilot coal gasification plants, which went into operation between 1977 and 1980, as well as the two coal liquefaction plants of Saarbergwerke AG and Ruhrkohle AG/Veba Oil AG. Between 1974 and 1984, the federal government and the state of North Rhine-Westphalia subsidized energy research costs with a total of DM 1.6 billion. Basic research was funded with government aid. The first large-scale coal gasification and coal liquefaction plants would come into operation in 1985/86, and, according to Hauff, they necessitated the expansion of nuclear power and the increase of domestic coal production.[48]

Hoechst participated in the government-sponsored coal conversion program through both its subsidiary Ruhrchemie and its plant engineering subsidiary Uhde GmbH. Since 1953, Uhde had held the right to implement the Texaco coal gasification process, and it cooperated closely with Ruhrchemie and Ruhrkohle – the two companies tested this method in the pilot plant at Oberhausen-Holten, where Uhde acted as the general contractor.[49] The synthesis gas plant, called Synthesegas-Anlage Ruhr GmbH (SAR), costed DM 220 million and began operations in August of 1986. The Federal Ministry for Research and Technology and North Rhine-Westphalia promoted the plant's development, providing DM 66 million between 1978 and 1982; the Federal Ministry of Economics contributed another DM 101 million for the construction of the commercial plant. From the early 1970s, Uhde also worked closely with

[48] Montan.dok BBA, 122/163, Hans-Dieter Schilling and U. Krauß, 1981, Kohlenveredelung und Kohlenverwendung, *Brennstoff-Wärme-Kraft* 33 (4): 130-4; BMFT-Mitteilungen 2/1980, 26.02.1980; LAK, 714/7626, *Saarberg* 2/1984, Neues Konzept zur Kohlehydrierung, S.16; LAK, 860/11027, BMFT/BMWi: Stand und Aussichten neuer Kohleveredelungstechnologien (05.06.1979), BMWi/BMFT: Kurzfassung zum Kohleveredelungsprogramm der Bundesregierung (28.01.1980), Kohleveredelung. Ungeahnte Risiken, 1980, *Wirtschaftswoche*, January 1; Vorrang für Kohle heißt Vorrang für Kernenergie, 1980, *Frankfurter Rundschau*, February 5; Ministerpräsidenten-Besprechung (25.02.1980), Kohleveredelung. Ohne falsche Euphorie, 1980, *Wirtschaftswoche*, March 7; Schröter 2000, 390-1. From 1970 to 1995 the German government provided coal research by Euro 2.2 billion. Cf. Schmalfeld 2008, 1.

[49] The Texaco coal gasification process proved itself capable of gasifying pulverized coal at high temperatures and pressures.

Rheinische Braunkohlenwerke AG, and in 1983 engineers built a large-scale gasification plant using the High Temperature Winkler process. Even abroad, Uhde was engaged in coal conversion and, in the early 1980s, took on the planning for a Swedish energy complex. The new government under Helmut Kohl followed its predecessor and promoted research and development in coal conversion. Federal Research Minister Heinz Riesenhuber (1982-93) and Federal Economic Minister Martin Bangemann (1984-88) glorified the future potential of the new technology at the inauguration of the two plants in Oberhausen and Berrenrath in 1986. Nevertheless, these were the only coal conversion projects intiated by the social-liberal coalition that ever reached production stage. SAR produced a mixture that was suitable as a raw material for the petrochemical industry; however, as fuel for households and industry, its prices were hopelessly inferior to natural gas in the mid-1980s.[50]

In the 1970s, chemical corporation leadership examined whether a return to improved coal technology would allow for the substitution of oil. In the end, the attempt suffered from the phantom pain of a past technology.[51] In the 1979 business report, Hoechst CEO Rolf Sammet emphasized once more that the burning of fossil fuels should be avoided in any case. Both oil and coal should be used for higher value products, while nuclear power should be used for energy. This strategy was put forward by Hoechst Board member Klaus Weissermel, who demanded a decoupling of raw material and energy.[52] In the final analysis, and even after the second oil crisis, Hoechst pursued an idea of decoupling that had already been developed in the late 1960s. Its realization failed for two key reasons. First, the desire of BASF, Hoechst, and other chemical corporations to produce their own nuclear energy was opposed by the public, which protested against siting nuclear power plants in metropolitan areas. Second, the methods of coal gasification and hydrogenation were mainly based on research from the 1930s and 1940s, and a broad-scale, economically viable implementation of the technology was hardly possible on account of the existing price relationships. As a consequence, and because oil prices dropped sharply in the first half of the 1980s, many projects were stopped in the planning phase. Sammet complained that, in 1979, only seven percent of crude oil

[50] The successor company ThyssenKrupp Uhde GmbH has kindly provided some documents on coal liquefaction: Uhde, ed., *Anlagen für die Kohletechnologie. Texaco-Vergasung* (Dortmund, 1987); Uhde Jahresbericht 1983, 10-3; Uhde Jahresbericht 1984, 12-3, Uhde Jahresbericht 1986, 18-20; BAH, Presseinformation Uhde Nr. 1, Kohle soll Importöl ersetzen. Uhde erhält Planungsauftrag für schwedischen Energiekomplex (27.05.1983), Presseinformation Uhde Nr. 6, Chemie aus Kohle – Ruhr-Kohle ersetzt importiertes Öl (10.11.1983), Bäumler 1989, 509-11; Schröter 2000, 393-4; WAUK, Business Report Hoechst 1981, 14; WWA, Dortmund, 32, no. 226; Petrochemie auf Kohlebasis, 1984, *Frankfurter Allgemeine Zeitung*, August 8.

[51] Abelshauser 2002, 456.

[52] Weissermel 1980, 144-8; WAUK, Business Report Hoechst 1979, 5, Hoechst heute no. 78, Ohne Kernkraft droht das Chaos, 32-7.

was converted into chemical products in West Germany, but he did not mention that the majority of Hoechst's production was consistently based on petrochemicals. In 1981, the Hoechst Group consumed about 9.5 billion kilowatt hours of electricity, 800,000 tons of heavy and light fuel oil, 400,000 tons of coal (including 300,000 tons of coke as raw material), and about one billion cubic meters of natural gas (including about 0.1 billion of which as raw material). Hence, the importance of crude oil as compared to coal had grown since 1977. Furthermore, it shows the increasing importance of natural gas as a key raw material for the company.[53]

Both BASF and Hoechst had completed the transition from coal to petrochemicals between 1955 to 1965. Even the second oil crisis did not put enough price pressure on the chemical industry to render a return of coal chemistry. Accordingly, the energy crises caused chemical companies to put more attention on energy savings and energy recovery. In terms of production, BASF radically reduced its capacity to create bulk plastics, which had come under significant price pressure due to changes in world market structures, and moved towards more profitable specialty plastics.[54] The situation at Hoechst was similar. From 1971 to 1981 its production rose by 43 percent, but, as a result of energy recovery systems, there was no increase in steam consumption. Hoechst invested more in power-heat coupling and sought a more efficient way to exploit existing oil reserves. Company management assumed that global oil consumption would hardly be reduced, despite savings and substitution tests. Therefore, the company developed corrosion inhibitors for drilling rigs, chemical additives for drilling muds, and special chemical flooding processes to resolve oil from rock.[55] In the plastics division, Hoechst faced similar challenges to those of BASF, lowering the production capacity of high-density polyethylene by about 40 percent in its West German facilities between 1981 and 1983. Instead, the company focused on producing engineered materials, which had been more resistant to the oil crises.[56] Even if the German government had signficantly subsidized coal conversion, because it wanted to ensure the security of the national energy supply and save the coal industry, chemical companies did not fundamentally shift their supplies of energy and raw materials for economic reasons.

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[53] Bäumler 1989, 491-2; WAUK, Business Report Hoechst 1979, 5, Business Report Hoechst 1981, 24-5. For comparison the energy use of Hoechst in 1977 (without raw material): coal (110,000t), oil (645,000t), gas (455 million m^2). WAUK, Business Report Hoechst 1977, 27.

[54] BAH, Schlächter, Hans, 1969, Die Energiestruktur und ihre Auswirkungen auf die Energiekosten in einem Unternehmen der chemischen Industrie, *VIK-Mitteilungen* 6/7; Bäumler 1989, 267-89; Schröter 1996, 129-35; Stokes, 1994.

[55] WAUK, Business Report Hoechst 1978, 12-4; Business Report Hoechst 1979, 12-3; Business Report Hoechst 1981, 24-5, 36-7; Hoechst heute, no. 94, Damit das Öl auch fließt, 6-7.

[56] Bäumler 1989, 346-8, 390-2.

4. Conclusion

In the end, both attempts to deal with the energy crises of the 1970s largely failed. Although the anticipation of future energy problems led to a diversification of energy sources and supplying countries, as well as to energy-saving measures, not all of the proposed strategies were successfully implemented. Moreover, coal conversion did not fundamentally change the West German energy structure; neither did company-owned nuclear power plants become reality. Even if the technological options had been available, political concerns and a lack of economic viability would have prevented the prevelance of the two methods. The problems in the energy and commodities sectors began prior to 1973, at least since the Middle East War in 1967 – both West German chemical companies and politicians realized this. The stable purchase situation changed, and requests for alternative raw materials and energy options became more pressing. Chemical companies had to face the demands of a growing environmental movement and cope with the technological change of the "third" Industrial Revolution.

The idea of combining nuclear energy and chemical production was one reaction to the 1970s' energy crises. Industrialists like Mandel, Winnacker, and Sammet anticipated future energy crises and wanted to implement an entirely different energy mix for West Germany. The hope for a new business segment, combined with the desire of the largest industrial electricity consumer to reduce its dependence on coal and oil, explain the economic interest in nuclear energy. BASF's application to construct its own nuclear power plant promised long-term energy security. But its rejection of the safety philosophy, which the federal government could not support for domestic and security policy reasons, represented a turning point in nuclear policy. Although the first energy program of the social-liberal coalition attributed a higher value to nuclear power, security concerns about an NPS in an urban and industrial area prevented approval. The decision was less technical and more political, as public skepticism about the new technology was growing. This political conflict crossed party lines. A permit would have set a precedent for similar applications. With the termination of its plans in 1976, BASF ended the controversy. In the final analysis, economic reasons tipped the balance toward a market solution. Even if chemical companies had dismissed the idea of an industrial NPS, a large part of the country's electric utilities' expansion was based on nuclear energy and, as the cases of BASF and Hoechst have shown, chemical companies purchased electricity from these companies. Thus, to a certain extent, the demands for nuclear power became a reality, and the makeup of German energy production changed fundamentally. Between 1980 and 1985, nuclear power became the most im-

portant electricity source among West German power supply companies. But the chemical companies missed their goal of energy autonomy.[57]

The revival of coal conversion was another attempt to prevent future energy crises, but economic reasons – namely, the lack of price pressures from coal and oil – prevented the technology from being implemented on a large scale. The effect of the oil price shock on West Germany's economy was much less than on other industrialized countries as a result of the currency appreciation. The political and business initiatives for coal conversion of the 1960s were in anticipation of the energy crises that occurred the following decade. From the perspective of the German government, securing national energy independence with coal made sense, but from a business perspective, companies could only go that route if it was economically reasonable – and, for coal gasification and liquefaction, this was hardly the case. The German government wanted to solve several problems at once. First, it wanted to end the long-running mining crisis. Second, it wanted to maintain the chemical industry's competitiveness by reducing its dependence on price fluctuations within the international commodity markets. Third, the government aimed to stop or, at least, slow down the increasing expenses in its balance of payments, and it initiated extensive subsidy programs following the planning euphoria of the boom period. New methods in coal conversion would support the exportation of technical knowledge and machinery, preserving the strength of the West German export economy. The two oil crises pushed the development of coal conversion. Chemical companies were willing to participate in such research, but only if the state took on the entrepreneurial risk and subsidized the investments.

However, almost none of these proceedings reached production stage. The industrial plants that went into operation in the mid-1980s only supplemented the existing German energy structure. The chemical industry wielded enormous influence on political decisions and purported to be innovative. In fact, it was only willing to do so with government support. German chemical companies adapted themselves to the higher oil prices – an expensive shift back to coal made no economic sense, and neither did the lack of large-scale systems during the 1970s make coal conversion an adequate short-term response to the actual crisis. Instead, chemical companies shifted their production of mass and standard products to higher-value goods and initiated extensive rationalization and energy efficiency programs. As such, coal regained importance within the West German chemical industry in the 1980s – after its decline in the late 1960s – while oil consumption could be significantly reduced. Modern systems for industrial heat and power generation, in particular, were responsible for these energy savings. Some companies relied more heavily on gas, but the chemical

[57] For the production of electricity of West German power supply companies, see Statistisches Bundesamt, ed., 1965-1990, *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, Stuttgart and Mainz: Kohlhammer.

industry's natural gas consumption stabilized after the economic crisis of 1974/75; in contrast, West German imports of natural gas have increased steadily since the late 1960s, which changed the national energy structure. Furthermore, the chemical industry succeeded in stopping the increase in its electricity needs – despite the chemical boom after the second oil crisis, their electricity consumption in the late 1980s was at 1974 levels. Therefore, West German chemical companies stayed competitive, even if electricity was not produced by their own nuclear power plants, but from those of power companies. Market-based solutions prevailed in the end.[58]

All in all, the energy crises left their mark. Both coping strategies point to a political-economic context and are characteristic of discussions about the industrialized world's energy configuration. In the two cases presented, the state acted as a central player, without which neither the termination of BASF's project nor the coal research of the 1970s could be explained. Despite cross-border trade, international capital flows, and the spread of multinational companies, the nation-state remained an indispensible actor in energy security. In an international context, coal liquefaction was implemented only in South Africa to avoid trade barriers, but the technology did not change global energy production. On the contrary, even though corporate-owned nuclear power stations were not approved in West Germany, nuclear energy became an important ingredient in energy generation on both sides of the Iron Curtain, and it led to the present-day controversies around Germany's energy transition.

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[58] For coal, natural gas, fuel oil and electricity consumption of the West German chemical industry, see Statistisches Bundesamt, ed., 1965-1990, *Statistisches Jahrbuch für die Bundesrepublik Deutschland,* Stuttgart and Mainz: Kohlhammer.

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